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(54) Title: <b>COVERING IN THE FORM OF A TILE OR A MAT</b> (57) Abstract <p>The invention relates to a covering in the form of a tile or a mat, prepared using a binder containing ethylene-butylacrylate copolymer (EBA). The covering according to the invention is especially suitable for covering floors and walls.</p>		

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Covering in the form of a tile or a mat

5 The invention relates to a covering in the form of a tile or a mat containing ethylene-butylacrylate copolymer (EBA) as a binder. The covering according to the invention is particularly suitable for covering floors and walls.

10 Polyvinyl chloride (PVC) has been used generally as a binder in the production of floor coverings. Such coverings are described e.g. in US 3,761,555, EP 106148 and EP 227029. PVC-based coverings have been considered to have e.g. physical properties superior to coverings containing no halogens, such as rubber and linoleum coverings, which were used widely  
15 previously.

However, it has been found that the use of halogen-containing materials such as PVC in coverings is disadvantageous e.g. in connection with electronic equipment, in power plant control cabins, fine elect-  
20 ronics industries and especially in environments with a risk of fire. Environmental considerations have also contributed to the increasing use of halogen-free materials for different purposes, such as packages and building materials. With respect to floor coverings,  
25 EP 321760 is referred to. This patent document teaches the use of ethyl vinyl acetate copolymer (EVA) as a basic binder component possibly with an addition of polypropylenes.

The object of the present invention was to  
30 provide a covering which contains no halogens, thus meeting the requirements of special fields and being environment-friendly. The covering must not contain any substances hazardous to health that evaporate at normal ambient temperatures into the surrounding  
35 space, such as solvents and plasticisers. In addition,

the product should be thermoplastic so that it can be machined by known techniques, and it should be recyclable. It is also necessary that the product can be produced in the form of tiles or a mat that can be rolled up, and the appearance of the product should be easily variable. Moreover, the installation and removal (for recycling) should be easy. Finally, the basic properties of the covering in use should correspond to those of known covering products. Such basic properties include not only different well-known mechanical properties such as resistance to depression (load), resistance to wear, and dimensional stability, but also cleansability.

The covering according to the present invention meets the basic criteria set forth above. Products disclosed in the above-mentioned EP Patent Specification 321761 meet partly some of the criteria, being e.g halogen-free, thermoplastic and recyclable. However, it has now been found out that the covering according to the present invention has significant advantages over the above-mentioned products.

The present invention relates to a covering which is in the form of a tile or a mat, has a wear-resistant surface, and is made of a mixture containing a binder, a filler and possibly additives. The covering is characterized in that the binder contains ethylene-butylacrylate copolymer (EBA).

The covering according to the invention is typically a semi-rigid tile or a flexible mat, and it may be homogenous or of sandwich-structure, of a single colour or patterned. The proportion of EBA in the binder used is preferably 20 to 80% by weight. Suitable EBA polymers are those having a butylacrylate content of 5 to 28%. To achieve and improve the desired properties typical of floor coverings, other

binders may be used in addition to EBA, such as various propylene polymers and copolymers, e.g. random polypropylenes. The total amount of binders in the covering is preferably 20 to 80% by weight based on the total weight of the covering. In addition to a binder the covering contains suitable inorganic or organic fillers and possibly additives. Suitable fillers include chalk, kaolin, limestone or dolomite powder, various silicate mineral powders, quartz powder or sand, and organic or inorganic fibres. Typical fillers include antistatic agents, photostabilizers, antioxidants, and colorants. The amount of the fillers and additives is preferably 20 to 80% by weight, of which the proportion of additives is generally no more than 5% by weight based on the total weight of the covering.

The covering according to the invention may be produced in a manner known per se by utilizing processes applied in the production of corresponding PVC-based products. For instance, the production of a floor tile containing mainly quartz sand (grain size 0.1 to 0.8 mm) as a filler and EBA and random polypropylenes as a binder takes place by mixing the filler and binder components together in a dry-mixer type device and melting the mixture so obtained in an extruder. The molten mixture is passed into a two-roll mill from which it is fed to a calender for calendering into a tile blank of a desired thickness. Melting may also be carried out directly by the two-roll mill. To achieve the final compact smooth surface, (a) the tile blank is fed as a continuous web into a so-called double-band press and compressed into a tile band which is cut into tiles of a desired size, e.g. 30 x 30 cm or 50 x 50 cm, or (b) the tile blank is cut into tiles of a suitable length, and the tiles are then

cooled and pressed in a separate step in a multiple unit press, and the finished blanks so obtained are cut into tiles of a desired size. The tiles may be patterned in the same way as PVC-based products by preparing grains of different colours and 1 to 15 mm in size of the same or partially modified material and mixing them cold with the hot material in the two-roll mill or squeezing them into the hot tile blank in the double-band or multiple-unit press.

10 In addition to being halogen-free, which is taken as a basic requirement, the properties of the covering according to the invention are superior to those of a corresponding PVC-based product in surprisingly many respects:

- 15 - It has been found that, with the same filler composition and the same binder/filler ratio, the covering according to the invention has a significantly greater stiffness in addition to other equally good properties, which is of vital importance in practical installation work and also affects the requirements concerning the underlying floor.
- 20 - The covering according to the invention has a clearly better depression resistance, which is one of the most important properties for floor coverings.
- 25 - The temperature range within which the covering according to the invention is usable is wider, i.e. the properties of the covering do not vary essentially as a function of temperature within the temperature range 0 to 50°C.
- 30 - The binder contained in the covering according to the invention provides better cold creep properties, i.e. a higher resistance to long-term load.
- The wear resistance of the covering according to the invention is clearly higher with the same filler/  
35 binder volume ratio.

- The covering according to the invention is about 20% lighter than the PVC-based product, which is significant for the handling, cost of transport and impact-sound damping properties.

5 - The dirt-repelling and general cleansability properties of the covering according to the invention are superior to those of PVC-based products.

- As the covering according to the invention does not contain any separate liquid plasticisers, no migration  
10 of plasticisers occurs to the surface of the covering nor do any external e.g. oil-soluble coloured or uncoloured substances penetrate from the surface of the covering deeper inside the covering as with PVC-based products.

15 - As to the friction properties, the covering according to the invention differs to its advantage from similar PVC-based products.

The covering according to the invention also differs significantly and surprisingly to its advantage from EVA-based coverings (see EP 321761) in that  
20 the temperature range within which the covering according to the invention is usable is wider, i.e. temperature changes affect the mechanical properties of the covering less than with EVA-based products. The  
25 dirt-repelling and cleansability properties of EBA-based floor coverings are essentially better than those of corresponding EVA-based coverings, the surface of which is rather sticky due to the binder composition used. The depression resistance and creep  
30 properties of the covering according to the invention are also superior to those of corresponding EVA-based products. It is further to be mentioned that the vinyl acetate contained in EVA-based products has been classified as a substance suspected of being carcinogenic.

The following examples are illustrative of the invention.

Example 1

5

A covering was prepared by using the following ingredients and amounts:

Ethylene-butylacrylate			
10	copolymer 1)	100.0 kg	25.8% by weight
	Polypropylene 2)	25.0 kg	6,5% by weight
	Calcium carbonate 3)	60.0 kg	15.5% by weight
	Sand 4)	190.0 kg	49.0% by weight
	Stabilizer 5)	0.01 kg	
15	Pigment 6)	12.5 kg	3.2% by weight

1) NCPE 8019, manufacturer Neste Oy, acrylate content 17%, melt index 1.5 g/10 min

2) Random copolymer, manufacturer Neste Oy, melt index  
20 1.8 g/10 min

3) Powdered limestone, grain size 10 to 200  $\mu\text{m}$

4) Natural sand, grain size 0 to 800  $\mu\text{m}$

5) CHIMASSORB 944 LD, manufacturer Ciba-Geigy

6)  $\text{TiO}_2$ , manufacturer Kemira Oy, RF2S

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The ingredients were mixed at room temperature into a homogenous mixture. The mixture was fed into a two-roll mill having a roll temperature of +210°C. During processing the temperature of the material  
30 increased to +195°C. From the mill the hot material was passed in the form of a continuous band into a tandem calender having a roll temperature of +140°C. The roll nip was adjusted so that the 70 cm wide band produced by the calender was 2.15 mm in thickness.  
35 Crushed grains of a desired colour prepared in advance



of the same material were sprinkled on the band for patterning. The grains were squeezed into the band by a pair of steel rolls. The band was then cut into blanks 100 cm in length, which were cooled to room temperature.

Blanks so prepared were arranged for compression between steel plates manufactured for the purpose, one blank per each pair of steel plates. Compression was carried out in a two-step multiple unit press. In the first step the temperature was +155°C, pressure 4 MPa and compression time 15 min. In the second step, the pressure was 8 MPa and compression time 12 min, and the plates were cooled to a final temperature of +30°C. The blanks were thus compressed into a thickness of 2.0 mm. They were cut into tiles 30 cm x 30 cm or 50 cm x 50 cm in size.

#### Example 2

A covering was prepared as described in Example 1 with the following ingredients and amounts:

	Ethylene-butylacrylate copolymer	100.0 kg	15.7% by weight
25	Polypropylene	167.0 kg	26.2% by weight
	Calcium carbonate	80.0 kg	12.6% by weight
	Sand	250.0 kg	39.2% by weight
	Cellulose fibre 1)	25.0 kg	3.9% by weight
	Stabilizer	0.07 kg	0.01% by weight
30	Calcium stearate	0.20 kg	0.03% by weight
	Pigment	15.0 kg	2.36% by weight

1) Arbocel PWC 500, J. Rettenmeier & Sohn

Average fibre length 700 µm

Average fibre thickness 35 µm

Measured properties of the prepared covering:

	m <sup>2</sup> - weight	DIN 53,352	2,698 g/m <sup>2</sup>
	Depression	DIN 51,955	0.07 mm
5	Residual depression	DIN 51,955	0.03 mm
	Wear (20 cycles)	DIN 51,963	0.09 mm
	Light resistance	DIN 53,387	7
	Fire classification	DIN 4,102	B1

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### Example 3

A covering was prepared as described in Example 1 with the following ingredients and amounts:

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	Ethylene-butylacrylate		
	copolymer	100.0 kg	8.4 % by weight
	Polypropylene	400.0 kg	33.4% by weight
	Calcium carbonate	150.0 kg	12.5% by weight
20	Sand	500.0 kg	41.8% by weight
	Cellulose fibre	25.0 kg	2.1% by weight
	Stabilizer	0.20 kg	0.02% by weight
	Calcium stearate	0.30 kg	0.03% by weight
	Antistatic agent 1)	1.0 kg	0.1% by weight
25	Pigment	20.0 kg	1.65% by weight

1) Lankrostat 104, Harcros Chemical Group

### Example 4

30

A covering was prepared as described in Example 1 with the following ingredients and amounts:

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	Ethylene-butylacrylate		
	copolymer 1)	100.0 kg	18.4% by weight
	Polypropylene	25.0 kg	4.6% by weight
	Calcium carbonate	125.0 kg	23.0% by weight
5	Sand	250.0 kg	46.0% by weight
	Cellulose fibre	30.0 kg	5.5% by weight
	Calcium stearate	0.05 kg	
	Stabilizer	0.01 kg	
	Antistatic agent	1.0 kg	0.2% by weight
10	Pigment	12.5 kg	2.3% by weight

1) NCPE 6427 Neste Oy, Acrylate content 27%, melt index 4 g/10 min

15           Example 5

A covering was prepared as described in Example 1 with the following ingredients and amounts:

20	Ethylene-butylacrylate		
	copolymer 1)	100.0 kg	20.4% by weight
	Polypropylene 2)	100.0 kg	20.4% by weight
	Calcium carbonate	100.0 kg	20.4% by weight
	Sand	150.0 kg	30.6% by weight
25	Cellulose fibre	30.0 kg	6.2% by weight
	Stabilizer	0.05 kg	
	Calcium stearate	0.05 kg	
	Pigment	10.0 kg	2.0% by weight
30	1) NCPE 6427		
	2) XB 60 50H, random copolymer, melt index 6.0 g/10 min		

## Claims:

1. Covering in the form of a tile or a mat having a wear-resistant surface, the covering being prepared of a mixture containing a binder, a filler and possibly additives, characterized in that the binder contains ethylene-butylacrylate copolymer (EBA).

2. Covering according to claim 1, characterized in that the amount of EBA is 20 to 80% by weight, based on the total amount of the binder.

3. Covering according to claim 1, characterized in that the covering contains 20 to 80 % by weight of the binder and 80 to 20% by weight of the filler and additives.

4. Covering according to claim 1, characterized in that the binder contains random polypropylene.

5. Covering according to claim 4, characterized in that the binder contains 20 to 80% by weight of random polypropylene.

6. Covering according to claim 1, characterized in that the covering contains 4 to 64% by weight of random polypropylene.

7. Covering according to claim 1, characterized in that the binder contains 20 to 80% by weight of EBA and 80 to 20% by weight of the random polypropylene, and that the covering contains 20 to 80% by weight of the binder and 80 to 20% by weight of the filler and additives, the proportion of the additives being no more than 5% by weight based on the total weight of the covering.

8. Covering according to claim 7, characterized in that the filler is mainly quartz sand.

9. Covering according to claim 1, c h a r a c-  
t e r i z e d in that it contains 15.7% by weight of  
EBA; 26.2% by weight of polypropylene; 12.6% by weight  
of calcium carbonate; 39.2% by weight of sand; 3.9% by  
5 weight of cellulose fibre; 0.01% by weight of stabil-  
izer; 0.03% by weight of calcium stearate; and 2.36%  
by weight of pigment.

10. Covering according to claim 1, c h a r a c-  
t e r i z e d in that the butylacrylate content of  
10 the EBA copolymer is 5 to 28% by weight.

## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/FI 93/00531

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: D06N 7/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: D06N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## WPI, CLAIMS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP, A1, 0019926 (UNION CARBIDE CORPORATION), 10 December 1980 (10.12.80), page 5, line 25 - line 28, abstract --	1-10
A	DE, A1, 3835131 (JOHANNES HEYEN), 19 April 1990 (19.04.90) -- -----	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

26/02/94

International application No.  
PCT/FI 93/00531

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0019926	10/12/80	BE-A- 883563 JP-A- 56053141	01/12/80 12/05/81
DE-A1- 3835131	19/04/90	NONE	

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